



Bulb Lamp LED Driver Module with the Active Power Factor Correction

AC Input Voltage Range	LED DC Output Voltage/Current	Output Power
90V _{AC} /60Hz ~ 264V _{AC} /50Hz	48V/160mA	7.68W

Key Features

- Universal input from 90V_{AC}/60Hz to 264V_{AC}/50Hz, LED DC 48V/160mA output
- One cycle control Power Factor Correction (PFC) and typical PF value > 0.95 @ 110/220 V_{AC}
- Fixed frequency buck converter and maximum efficiency @ 110/220 V_{AC} : 89%
- LED output current variation within $\pm 3\%$
- Highly Integrated with built in MOSFET
- Dimension : 30mm x 18mm x 19mm
- Typical application : bulb lamps

Introduction

This application note describes a constant current bulb lamp power module with one cycle control active power factor correction for full range input voltage from 90V_{AC} ~ 285V_{AC} by adopting the SQ6214. Based on buck PFC topology, the SQ6214 is able to achieve high power factor value for bulb lighting application. This application provides multiple advanced fault protections to enhance the systems safety, including natural Open Loop Protection (OLP), Short Circuit Protection (SCP), V_{DD} under-voltage lockout and thermal shut down. All protections have auto-restart mechanisms. Schematics, PCB Gerber, BOM, as well as typical performance are covered in details by this application note. A complete application circuit is depicted in Figure 5, which can work on universal input voltage range from 90V_{AC} ~ 264V_{AC}.

Specification

The Table 1 represents the specification that this design intends to achieve.

Performance

It is to drive output at 48V/160mA targeting to achieve high efficiency ($\eta_{MAX}=89\%$), high power factor (typical PF > 0.95) and current accuracy for AC universal input voltage range 90V_{AC} ~ 285V_{AC}. Actual performance is shown on Table 2. Figure 1, 2, 3 and 4 depict power factor, output current, current variation and efficiency at AC input voltage range 90V_{AC} ~ 264V_{AC} for this module that system designer can adopt it to achieve corresponding performance.

BOM

BOM is shown in Table 3.

PCB Layout

The PCB layout has dimension at 30mm x 18mm x 1.6mm in order to fit bulb lamp space.

Power Module Photo

Pictures of power module and key components are shown in Figure 6 and 7.



Table 1. Related Specification

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
AC input voltage	V _{AC}	90		264	V	
LED DC output voltage	V _{OUT}		48		V	
LED output current	I _{OUT(SET)}		160		mA	

Table 2. Actual Performance

AC Input	Input Power (W)	Output Current (I _{OUT} , mA)	Output Voltage (V _{OUT} , V)	Current Variation (%) ^(Note)	Efficiency (η, %)	PF
90V _{AC} /60Hz	8.73	161	48	0.6	88.5	0.972
100V _{AC} /60Hz	8.72	162	48	1.3	89.2	0.975
110V _{AC} /60Hz	8.76	162	48	1.3	88.8	0.975
120V _{AC} /60Hz	8.77	162	48	1.3	88.7	0.975
132V _{AC} /60Hz	8.78	163	48	1.9	89.1	0.974
180V _{AC} /50Hz	8.75	164	48	2.5	90.0	0.962
200V _{AC} /50Hz	8.80	164	48	2.5	89.5	0.956
220V _{AC} /50Hz	8.85	164	48	2.5	88.9	0.948
240V _{AC} /50Hz	8.91	164	48	2.5	88.4	0.941
264V _{AC} /50Hz	8.97	165	48	3.1	88.3	0.930

Note :

Current Variation is defined as follows :

$$\% = \frac{I_{OUT} - I_{OUT(SET)}}{I_{OUT(SET)}} \times 100\%$$

where I_{OUT(SET)} = 160 mA

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Figure 1. Power Factor for AC Input Voltage Range 90V_{AC} ~ 264V_{AC}

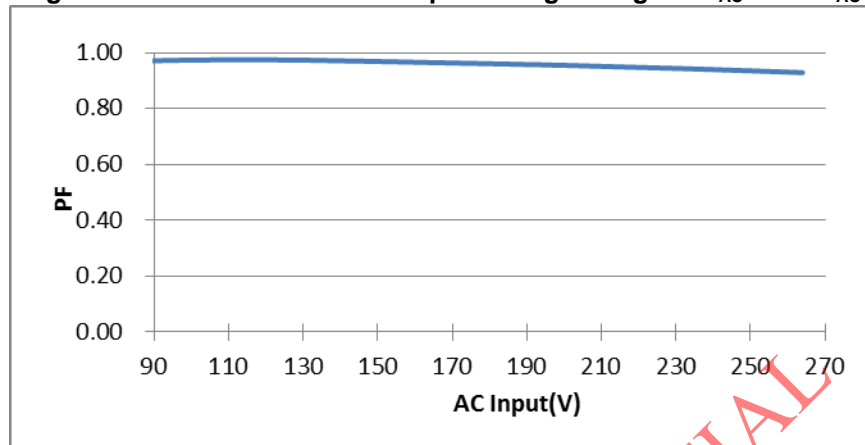


Figure 2. Output Current for AC Input Voltage Range 90V_{AC} ~ 264V_{AC}

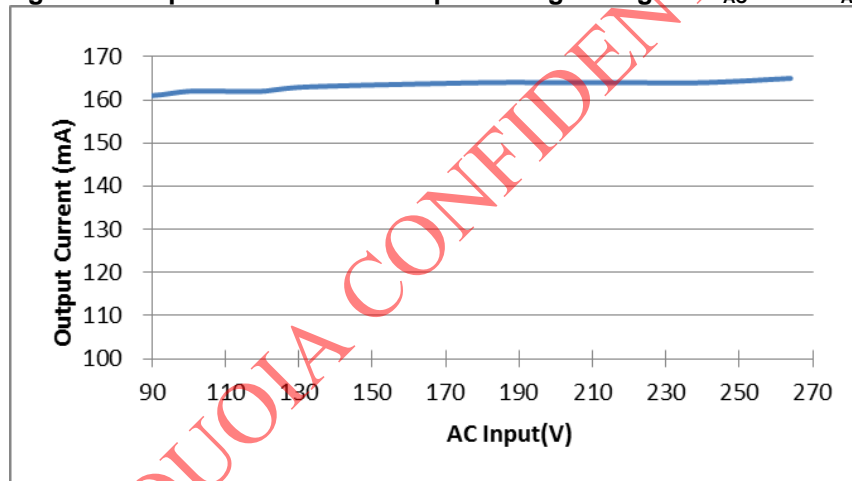


Figure 3. Current Variation for AC Input Voltage Range 90V_{AC} ~ 264V_{AC}

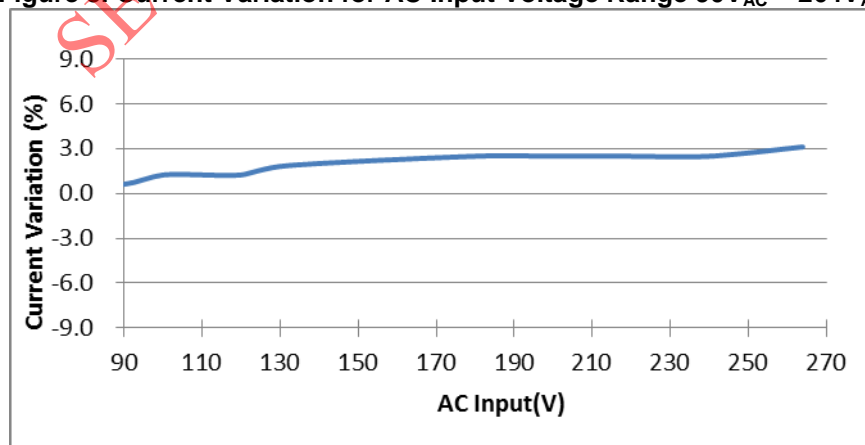
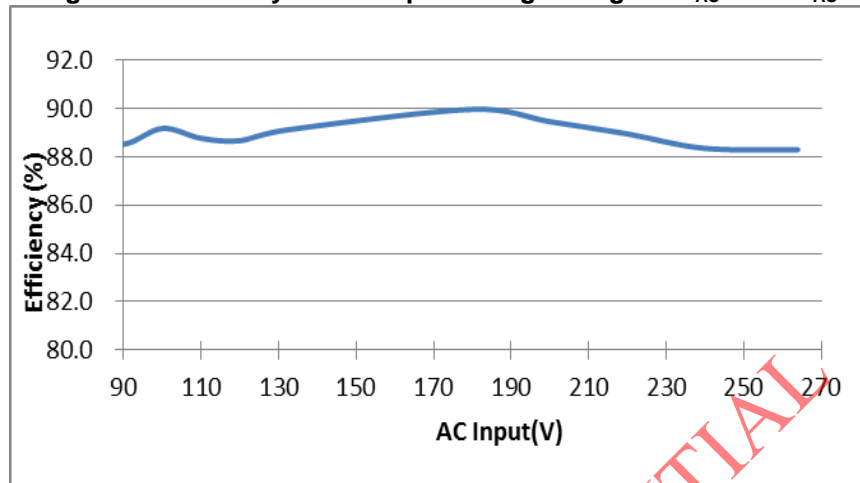




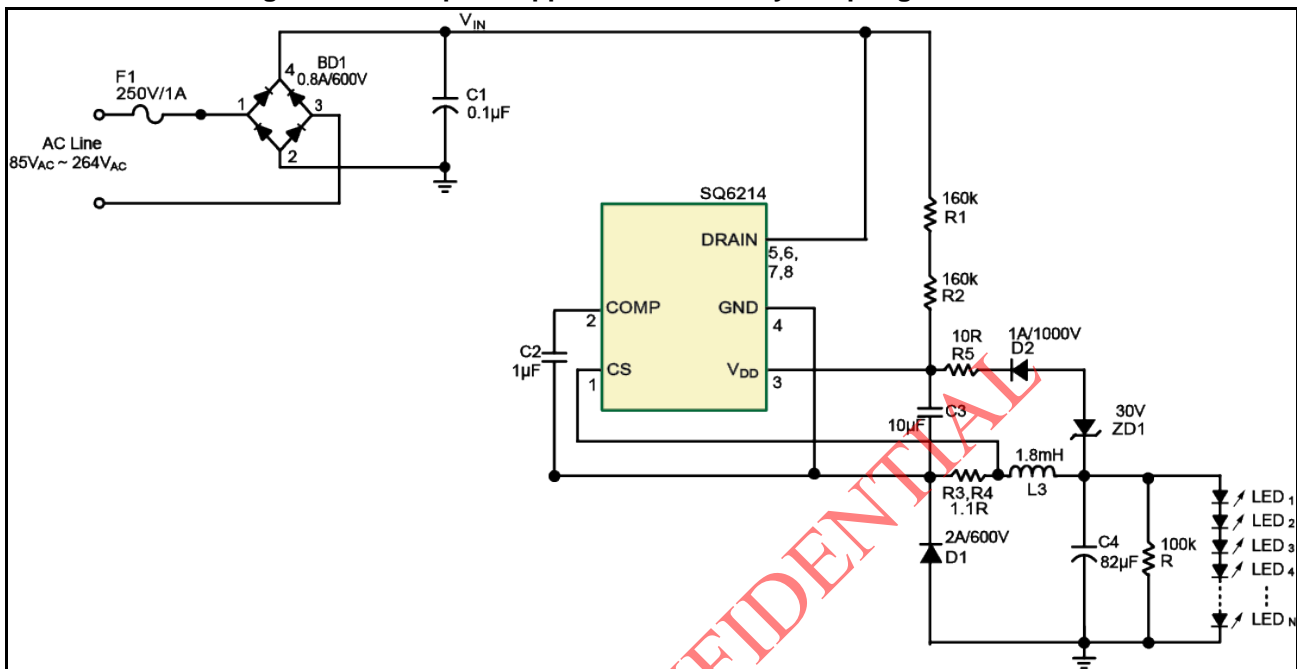
Figure 4. Efficiency for AC Input Voltage Range 90V_{AC} ~ 264V_{AC}



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Figure 5. A Complete Application Circuit by Adopting the SQ6214



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Table 3 : Bill of Material

Item	Symbol	Description	Category	Qty	Note
1	R1 R2	160K/0805/5%	Resistor	2	
2	R3	2.2k/1206/F	Resistor	1	
3	R4	2.2k/1206/F	Resistor	1	
4	R5	10R/0805/5%	Resistor	1	
5	R6	100k/0805/J	Resistor	1	
6	C1	104/400V CBB PIN:10mm	Capacitor	1	
7	C3	10uF,50V,YXM 105°C	Capacitor	1	
8	C2	1uF 0805 50V	Capacitor	1	
9	C4	82uF 63V 8*10mm 105°C	Capacitor	1	
10	DB1	MD7L 0.8A600V	Bridge	1	
11	CX1	104/275V CX2 PIN:10mm	Capacitor	1	
12	D1	2A600V,SF208A,Super Fast diode	Diode	1	
13	D2	1A1000V,SMA,FFM107,Fast diode	Diode	1	
14	L3	1.8mH,10Φ*16mm	Choke	1	
15	F1	1A/250V Slow 3.6*10mm	FUSE	1	
16	ZD1	ZMM5256B (30V zener)	Zener	1	
17	U1	SQ6214 SOP-8	IC	1	
18	PCB	PCB : FR-1 L30mm*W18mm*T1.0mm	PCB	1	
19	U1	SQ6214 SOP-8	IC	1	

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Figure 6. Picture of Top Side of the Power Module



Figure 7. Picture of Bottom Side of the Power Module



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